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ABSTRACT

This study is an attempt to identify one source of individual differences in the extent to which readers learn from text and the means for accommodating it. Eighty college students were administered a series of aptitude tests and randomly assigned to one of four treatment groups. The subjects then received six passages, each passage followed by a question. The type of question was dependent upon treatment. Following the presentation of the stimulus materials in treatments, subjects were given recognition and recall tasks. The recognition task consisted of 24 multiple choice questions. The recall task instructed subjects to write down as many inferences as they could remember from each passage. The same tasks were used 24 to 48 hours later to obtain measures of delayed recall and recognition. The prime dependent measures were recognition of inferences and total recall of productive inferences. The recall measure was further broken down to recall of superordinate inferences, coordinate inferences, and associative inferences. Among the conclusions drawn were the following: (1) individual differences in inferential behavior do occur in text processing, (2) some of these differences are predictable using prior measures of relevant aptitudes, and (3) certain treatments do interact with certain aptitudes. (WR)

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A study of text processing and intrinsic individual differences in conceptual organization.1

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Introduction

Are there individual differences in the extent to which readers learn from text? Obviously there are, as evidenced by classroom examination or simply by a discussion of a recently read book. Much formal instruction depends upon reading. And if the goal of instruction is to increase the probability that specified learnings will occur for all students, then it would seem appropriate that those responsible for developing instruction should understand sources of individual differences in learning from text and how they might be accommodated. This study is an attempt to identify one source and the means for accommodating it.

What is meant by learning from text? Frase (1969) speaks of the variability in the knowledge learners may acquire from text, and proposes three possible outcomes of learner interaction with the material. One may a) simply not learn, b) learn the text, c) or learn <u>from</u> the text. To the extent that one learns <u>from</u> the text, he is fulfilling the notion of "going beyond the information given" described by Bruner (1957). He is generating productive knowledge as opposed to only reproductive knowledge (Frase, 1970) for purposes of his own organization and retrieval.

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"Going beyond the information given" requires of the learner a level of information processing characterized by the use of concepts which goes beyond simple recognition or literal comprehension. The learner must recognize the information at the level of literal comprehension and then manipulate that information in such a way that inferences, or productive knowledge, are derived.

This process may be defined in the terms of conceptual behavior. A conceptual response is the result of "the organization of a stimulus configuration in order to arrive at a basis of similarity among a group of stimuli and the assignment of a symbolic label (usually a language response) to the organized pattern of similar responses (Kagan, et al. 1960, p. 261)." Given a text passage, the reader may encode discreet exemplars of known concepts or may seek to combine that information be devising a basis of similarity. In the latter case, the reader is combining or modifying concepts to form the foundation for generating inferences.

What may be a source of individual differences in learning from text? This ability to engage in productive knowledge is subject to individual differences for the rather obvious reason that prior learning and habits will differ. Bruner (1957) offers that the process of categorization in conceptual behavior is an act of invention. These acts lead to "generic coding activities" in the learner "influenced in a permanent way be the regimen of one's past history (1957, p. 300)." To the extent that one way of combining or categorizing information may be more powerful than others for generating reproductive knowledge, the construct "conceptual style" may offer a direction for understanding individual differences. Kagan observes that, "in a given stimulus situation, individuals will differ in their tendency to use one class of

concepts as opposed to another; that is, they will differ in their preferred mode of organizing and labeling stimuli (1960, p. 202)."

When considering individual differences, there must be a concern for psychological processes which include mediating activities in the learner. A univariate S-R framework fails to be appropriate because it does not attend to variability of responses due to prior learning. A psychological theory is required which leads to the specification of cognitive process in which the learner's response is a function of the interaction of both the internal stimulus and the internally imposed response by the learner. Glanzer's R-R theory (1967) and Melton's multi-process model of associative learning (1967) lead to a conceptualization of the possible effects of intervening events as influenced by prior mediational habits. Such habits could be said to lead to what Jensen (1966, 1967) refers to as intrinsic individual differences. In contrast to extrinsic individual differences which have an effect on learning, intrinsic differences pose their effects in learning. They are inherent in learning and do not exist independently of it and, according to Jensen, offer the more fruitful investigation of individual differences and concept learning. Rather than speak in vague terms about personality characteristics or gross measures of mental ability in our exploration of individual differences, we must be concerned with genotypic processes. One process of immediate relevance to this study concerns the learner's verbal associative network as revealed through "phenomena such as chained word associations, the degree of subjective organization and associative clustering in the free recall of verbal materials, the differential effects of varying degrees of meaningfulness or association value on the rate of acquisition in verbal learning tasks, and the differential rates of learning in tasks which differ in the amounts and kinds of verbal or symbolic mediation that they involve (Jensen, 1967, p. 133)."

Although Jensen is not specific about what is meant by "kinds of verbal or symbolic mediation," one may look at different kinds of conceptual structures occurring in a hierarchy. Given the hypothesized hierarchical structure of knowledge and language in cognitive processing and memory (Mandler, 1968) one can look for possible alternative relationships that occur within the hierarchical structure and which may determine individual differences. Three relationships are evident. First, exemplars of a concept may be coordinate. They are equivalent with respect to a higher order denotation. "Mammal" and "fish" are coordinate exemplars of "animals". Second, exemplars of a concept may be superordinate. "Fish" and "mammal" are each subordinate to "animals". A third relationship may be termed associative and is achieved by the sharing of an exemplar by two or more hierarchies. This relationship is an association learned through contexts in which the exemplar is used and thus achieves a level of "relatedness".

Bousefield (1953) argues that recall of coordinate items in a structure is facilitated by mediation based on equivalence. Clustering in recall of coordinate items occurs because there was mediation by a concept name or some nonverbal equivalent. Recall of coordinate items may, in turn, activate the superordinate structure. To the extent that this activation provides a "relatedness increment" to the remaining items in the structure, the probability of recall of these items is increased. And the strength of the "relatedness increment" may be hypothesized to vary with respect to individual differences in prior learning. Bousefield implies the same sort of argument for the case of initial recall of superordinate items.

Given the arousal and recall of items in one particular associative relationship (i.e. superordinate) a function of some probability, we may view

that probability in terms of individual difference hypotheses. The fact that such differences do occur is supported by the verbal learning literature.

Jensen, as has been noted, points out the relevance of this literature for the study of verbal associative networks and intrinsic individual differences in organizing behavior. The meaning of a concept is expressed in the word it elicits and therefore one would look toward word association and clustering tasks for one means of operationalizing conceptual or categorizing behavior (Bousefield, 1961; Deese, 1965; Kendler, 1964).

We can look at word association in the same way we earlier viewed hierarchical relationships among words. Woodworth (1939) offers a classification system for experimental purposes. In word association tasks, he poses four responses types: Defining or definitional responses which include subordinate/superordinate responses. Second are coordinate and contrastive responses where the word "and" or "or" may be inserted between the stimulus and the response. They would be found on the same "levels" of a hierarchy but on different branches (i.e. table-chair). The "coordinate" and "superordinate" type responses would come under the classification of a "paradigmatic" response, a term found in more recent studies of word association (Cramer, 1968). The paradigmatic response is one that belongs to the same grammatical category as the stimulus. Third are completion or predication responses. These are responses which serve to "carry out an idea" (dog-run), state a relationship of "coexistence (Sunday-church) or make a statement of "matter-of-fact predicate" (spinach-green). This class of response would be classified as "syntagmatic" as opposed to "paradigmatic". The syntagmatic response is learned through contextual contiguity -- that is contiguity resulting from the sequential arrangement of speech (Cramer, 1968). (For the purpose of the present study, the third response type will be called (associative".) And fourth, the valuations

and personal associations which are subjective and may be highly idiosyncratic. This response type will not be considered in the present study.

To what extent do responses vary between individuals given the same stimulus word? Using the Kent-Rosanoff word list, Woodrow and Lowell (1916) demonstrated an immediately apparent extrinsic individual difference -- age -- in response types.[2]

In studies of category clustering and subjective organization, there is clear evidence of individual difference in conceptual organization, particularly as normed relatedness measures of the stimulus words decline (Cofer, 1965; Marshall, 1967; Seibel, 1967).

There is a useful analogy to be made between some assumptions about clustering and subjective organization and assumptions about text learning in a mathemagenic behavior context.

In studies of mathemagenic behavior, the effective stimulus is the psychological consequence of the learners exposure to the nominal stimuli. It can only be inferred and becomes the indirect determiners of what is learned. The effective stimuli result in the formation of appropriate associations between sentence components, syntax, and semantic cues. The effective stimuli,

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2. The responses of 1,000 men and women and 1,000 children to the word list were compared. Given the word "table", for example, the most frequent response by the children was the word "eat", an associative response. To the same word, the most frequent response by the adult group was the word "chair", a coordinate response. But, even though the most typical response by the adult in this extensive study was coordinate, there remained a significant proportion of adults offering other classes of responses. Although in response to the word "dark", 43% of the adults responded "light", 22% responded with "night", the same associative response offered by 42% of the children. This variance among adults was consistently demonstrated throughout the list.

to the extent they are effective, may be said to facilitate learning from the text as opposed to learning the text. The learner "can produce statements which represent information which is only implicit in the simple sentences he has read (Frase, 1969, p. 1)."

To the extent that a learner does go beyond the information given, that he learns from the text, he is engaging in productive cognitive process as opposed to reproductive processing (Frase, 1970). At the conclusion of text processing, memory will consist to varying extents of productive and reproductive content. Reproductive content are those relations which occur within sentences. Recall of the sentence fulfills the requirement of reproductive processing. Productive recall requires the processing and retention of relations between sentences, and is the product of inferential behavior. It is the formation of remote, as opposed to immediate, relations of logical classes within the text materials. (It should be noted that productive content is always relative to reproductive content, the latter being the substance from which inferences are made).

Clustering then, becomes analogous to productive processing and recall. Just as in the verbal learning clustering paradigms, clustering of a sort also occurs in the recall of content from text. Operationalization becomes quite similar. Serially presented, contiguous words are replaced by serially presented, contiguous sentences. The dependent variable becomes, instead of clustered words (in no resemblance to the order or presentation), the recall of inferential statements which may bear no resemblance to the sentences in the origianl text.

And, just as hypothesized individual differences have been predicted in word clustering, we would hypothesize the same differences to occur in

the clustering of (production of) these logical classes of information found in text.

Also of relevance to the study is the use of the adjunct aids, as defined in the context of mathemagenic behavior. Instructional control over learning from text is accomplished by the use of adjunct aids. Their purpose is to "direct attention and guide learning by making use of the cue properties within a text, and the cue properties of the knowledge and response events that consequently emerge." Thus, "... activities that mediate learning can be manipulated by the introduction of verbal events that precede reading. These events modify processing activities which in turn determine the nature of the effective stimuli. By making explicit these prior events and their relationship to nominal text stimuli and learning outcomes, we may be able to arrive at a deeper conception of implicit learner-generated processes (Frase, 1971, p. 19)."

Of particular interest in this study is the control of inferential behaviors by the use of questions (the adjunct aid) as compensators for individual differences in processing.

In summary, we predicted that individual differences would occur in text processing defined as preferences or predispositions toward coordinate, superordinate or associative clustering of information and that the resulting inferences made by readers would reflect these predispositions. Second, an adjunct aid in the form of a cue question would serve to accommodate or compensate for these individual differences.

Method and Variables

Eighty subjects were recruited and paid for attending three sessions spaced over four days. During the first session a series of aptitude tests were administered. At the second meeting, Ss were randomly assigned to one of four treatments, and recognition and recall data were collected. During a third session, between 24 and 48 hours after the second, delayed recognition and recall measures were taken.

The aptitude measures included: 1) Siegal and Siegal measure of Education Set (1965), which attempts to discriminate between learners who are "predispositioned" to a "factual set" as opposed to a "conceptual set" for the learning of verbal material. The learner with a factual set tends, more than the "conceptualizer", to assimilate and presumably retrieve information without relating it to any conceptual whole. The information may not be meaningfully subsumed. The learner is not going beyond the information given and is relating to content at a reproductive level. On the other hand, the conceptually set learner is more likely to cluster and interrelate information. This learner makes active use of known concepts by subsuming new information under them. He is engaging in productive cognitive activities, as opposed to reproductive. 2) A vocabulary test adopted from the Henmon-Nelson Tests of Mental Ability (1929). 3) Measures of syllogistic reasoning (deduction) from the French Tests for Cognitive Abilities (1963). Specifically, tests RS-1 and RS-3 were used. The text passages, to be described shortly, required Ss to use deduction to arrive at the desired inferences. 4) A fourth measure attempted to determine S preferences for superordinate, coordinate and associative organization. Briefly, Ss were presented four decks of cards. Each deck contained six cards, with two words on a card. The words on three of the six cards were in either a superordinate, coordinate or associative relationship. Ss were instructed to rank order the word pairs from "most go

together" to "least go together". Figure 1 provides an example of one of the word sets and it's derivation. Totalling the rank orders (from 1 to 6) for each relevant word pair in the four decks provided an ipsative measure of S preference for each organization type.

FIGURE 1

During the second meeting, Ss received the stimulus material in randomly assigned treatments. Treatments were defined by the type of question (adjunct aid) S received after reading each of six passages. T_1 cued an inference derived from the organization of information in a superordinate relationship, T_2 cued an inference from information in a coordinate relationship, T_3 cued an inference in an associative relationship, and T_4 cued irrelevant information and thus acted as a control.

The six text passages read by all Ss were fabricated in a manner similar to the generation of the words in the category preference test. Each passage has a hierarchical structure containing coordinate, superordinate and associative relationships. The first paragraph, for example, can be graphically represented as shown in Figure 2.

FIGURE 2

The order of the sentence "types" in all paragraphs is the same, as is the number of sentences per passage - eleven. The order of "relevant content" sentences follows the order shown in Figure 2. There are three types of sentences in each passage. The critical sentences contain relevant exemplars

corresponding to the positions shown in the hierarchy. Two such sentences are required to establish a potential relationship. That relationship is provided by a second type of sentence which gives a generalization and the link for the relationship of the exemplars. The exception is for the associative relationship where the S provides the mediating generalization. The third type of sentence is for "filler". Between each of the first two types of sentences is a "filler" sentence which bears no relationship to the structure of the passage. (The first of the six passages and its analysis can be found in the appendix).

In summary, Ss received 6 passages -- each followed by a question. The type of question was dependent upon treatment. The question is hypothesized to facilitate (as an adjunct aid) organization of information after the passage is read -- the product of that organization is an S generated inference.

Following the presentation of the stimulus materials in treatments, Ss were given recognition and recall tasks. The recognition task consisted of 24 multiple choice questions -- a pooling of all questions used in all treatments. The recall task instructed Ss to write down as many inferences as they could remember from each passage. The same tasks were used 24 to 48 hours later to obtain measures of delayed recall and recognition.

The prime dependent measures were productive recognition (recognition of inferences) and total recall of productive inferences. The recall measure was further broken down to recall of superordinate inferences, coordinate inferences and associative inferences.

Analysis

The analysis of the data provided was largely exploratory which reflects the nature of this study. As you may have noted, we have only given brief attention to our hypothesis. The analysis was primarily directed toward exploring potentials for aptitude - treatment interactions. Analysis techniques included application of a 2-way ANOVA randomized group design and regression analyses. The ANOVA was used to indicate treatment main effects and, with lesser confidence, aptitude main effects. Regression alone was used to assess interactions.[3]

Cronbach and Snow (1969) recommend adoption of the homogeneity of group regressions test for determining the differences in regression slopes among treatments for cases in which there is one predictor variable. Therefore, whenever there occurred significant correlations ($p < .07$) between a predictor and dependent measure in more than one treatment, their group regressions were tested for parallelness (Edwards, 1968).[4] Rejection of the null hypothesis for parallel slopes were followed by application of the Johnson-Neyman technique (as reported in Borich, 1971) to determine the region (if interaction ordinal) or regions (if interaction disordinal) of significance.

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3. The reason for lack of confidence in reporting the effects of interactions via ANOVA results from the potential insensitivity of ANOVA in dealing with predictor variance. Inherent in complex ANOVA is the need to lump predictor measures into discreet categories. There is no problem when using a blocking variable which is nominal (such as sex) and easily dichotomized with no loss of variance. But, when the blocking variable consists of ordinal or interval data, as is the case in this study, the blocking may reduce the variance and the ANOVA design becomes weakened in its sensitivity to account for the predictor effects and detecting interactions.

4. The .07 level corresponds to the somewhat arbitrarily selected lower correlation limit of .400.

There remains the question of the relative "power" of the predictors. That is, the variance accounted for by a predictor in two or more treatments may not be of the same magnitude (although significant in each) relative to other predictors. In order to assess such outcomes, a step-wise regression was performed within all treatments for each dependent measure. The resulting ranking of the predictors in terms of variance accounted for helped to evaluate the power of predictors or clusters of predictors in observed interactions (and to simply gain some understanding of the conceptual organizing activities of Ss in particular treatments). This latter treatment of the data served to scale down the variables to a more mangeable number for purposes of discussing the main outcomes of this study.

Results

In this report, we will only present some of the more interesting trends observed. Of prime concern will be the effects of predictor variables V (verbal ability) and Siegal and Siegal (Educational Set), and the effects of treatments one and four (superordinate cue and irrelevant cue).

As would be predicted by an ATI hypotheses, there were no main effects for treatments. The Siegal and Siegal measure was consistently observed as having a significant main effect on performance. Figure 3 shows this relationship for the main recall and recognition measures.

FIGURE 3

It will be recalled that Ss high on the Siegal and Siegal measure are defined as "conceptualizers" and prefer tasks requiring meaningful subsumption of information and generation of inferential knowledge. The results

indicate that, in general, high conceptualizers do recognize and recall inferential material better than their lower counterparts - the "factualizers" - regardless of treatment.

No main effects were observed for treatments or interactions, however there is a trend in the data which invites comment. Figure 3 showing mean values for each treatment, represents the observation that T_1 tends to facilitate performances for "high" Ss on both productive recognition and total recall and depreciates performance for "low" Ss, while other treatments have little effect. T_1 provided the superordinate cue. It may be suggested that "high" Ss on S & S tend to make use of the cue for organizational purposes and that the cue presumably supplies a facilitating scheme for Ss prone to favor tasks requiring superordinate organizing.

The step-wise regression provides support for this observation. Within T_1, S & S emerged as the predictor accounting for the most variance on all major dependent variables. Correlations are in excess of .50 which is significant at the .01 level.

The verbal aptitude provided a significant discriminator among Ss of performance on the primary dependent measures as shown in Figure 4. With the ANOVA analysis, there were no significant effects for treatments or interactions.

FIGURE 4

The step-wise regression indicates that V accounts for the most variance in T_4 on each primary dependent variable. V did not emerge as a first order predictor in any other treatment, however there was a tendency for an interaction effect with T_1 and this will be presented later in this discussion.

Within T_4, the observations indicate that verbal aptitude is positively associated with ability to recall and recognize inferences - without the assist of cues. Given that verbal ability does not account for high protions of variance in other treatments, (one may specualte that the cues provided by other treatments) are not compatible with the organizing schemes which high verbal Ss provide for themselves. T_4, in turn, provides minimal interference.

Inspection of the means in Figure 4 suggests that there is an interaction effect. The step-wise regression, as mentioned above, did reveal V as a second order predictor in T_1, accounting for approximately 10% additional variance to S & S on immediate and delayed recognition, and total recall.

Tests for parallel slopes resulted in a trend toward an interaction only on total recall. Although the probability of the slopes being non-parallel was at the .25 level, the trend is viewed as worth reporting because it appeared to fit an overall trend in the results. The interaction is shown graphically in Figure 5.

FIGURE 5

The interaction provides marginal evidence for the speculation that inference recall in "low" verbal Ss is facilitated by superordinately organized cue questions.

These results with the verbal and Siegal and Siegal predictors suggested some pay-offs for further analysis which would combine their effects on predicting immediate recognition. The ATI analysis using two predictors (Borich, 1971) revealed an interaction with regions of significance but the homogeneity of group regressions test ($p = .23$) was below the required level.

However, it is interesting to note that an interaction for verbal ability alone and an interaction for Siegal and Siegal alone were less -- .18 and .13 respectively. For illustrative purposes only, we can suggest there is a tenable case for a two-way interaction. If one were to assign students to treatments on the basis of this analysis, students who scored about 115 or above on Siegal and Siegal and about 15 or below on the vocabulary measure would be assigned to treatment 1 (superordinate cue) all other cases should be assigned to treatment 4.

Another trend emerged which is of some interest. You will recall that earlier I described an organizing preference measure. That measure proved to provide little in the way of prediction until delayed measures were examined. On delayed total recall preference measures significantly predict performance within corresponding treatments at $p<.05$.

If the observation is for reasons other than chance, it would appear that preference measures may have some predictive validity as the time between reading and recall increases. Further, a particular preference becomes predictive of recall when a corresponding cue question is applied. For example, in T_1 where a superordinate cue followed the text, Ss demonstrating high preference for superordinate groupings are, over time, aided by the superordinate cue. It may be inferred that the cue facilitates regeneration of the entire

hierarchy. In view of the fact that the preferences failed to emerge as predictors of superordinate, coordinate and associative inference recall and thereby support the prediction that cues would be compensatory; the results tenuously suggest instead that the cues enhance recall for those exhibiting the preference, and that the enhancement is a delayed influence (or on influence overridden by other abilities which are brought to bear on immediate recall).

Conclusions and Recommendations

The general conclusions to be offered by this study are: 1) that individual differences in inferential behavior (going beycnd the information given) do occur in text processing, 2) that some of these differences are predictable using prior measures of relevant aptitudes, 3) that certain treatments provided in this study do interact with certain of these aptitudes, and 4) that treatments may be differentially functional or dysfunctional in their effect on recall and recognition of learner-generated inferences from text.

In terms of the earlier discussion of conceptual behavior and organization, we might first return to Bousefield's (1953) notion of hierarchy regeneration as a function of coordinate or superordinate clustering. Given the hierarchical structures of the passages used in this study, it may generally be stated that a superordinate organizing scheme (T_1) was most facilitating for regeneration of the hierarchy. The word "generally" is inserted because not all Ss experienced facilitated performance under the conditions of T_1. But, the trends in the results do infer that most Ss who were "forced" to use superordinate, as opposed to coordinate or associative, clustering in their organizing of the content excell in learning from text.

But individual differences did occur. When taking into account the various aptitudes related to conceptual behavior, it was found that a superordinate cue was debilitating for some Ss, and performance was facilitated when these Ss were left to their own resources under the conditions of T_4. It can only be inferred that these Ss generated other, idiosyncratic clustering schemes or concepts which were found more useful than those provided by E. Therefore, this study did make a beginning in its attempt to predict and account for variance in the organization of verbal material due to individual differences in learners.

There is one question remaining about the nature of the superordinate organization cue and the structure of the experimental passage that begs some brief discussion. What is it about this cue that appears to facilitate regeneration of the hierarchy? Is it a general phenomenon or specific to this study and the nature of the text passages? Given the "placement" of the superordinate relation which was constant in all the passages, it may be observed that the content associated with the superordinate relationship is anchored at each "end". That is, the superordinate information is linked with the subordinate and the coordinate information. Thus, once the superordinate information is recalled (or cued) there is the potential for generating the hierarchy in two directions (vertically and horizontally). The coordinate relationship, on the other hand, is anchored at only one "end". Its potential for activating the hierarchy is thus proportionately reduced. (This may be a partial explanation for the rather consistent nonfacilitating nature of T_2 in the study). What would happen if the "position" of the superordinate relationship were changed in a hierarchy? Instead of the pattern used in this study (Figure 6, left figure) what would be the effect of a superordinate cue on a hierarchy such as the one on the right? It is now

the coordinate items that have dual anchoring. Would a coordinate cue in this instance be the more facilitating on the average?

FIGURE 6

For the general case where questions, prompts or cues are used to facilitate learning (i.e. prior questions or statements as advanced organizers, and questions posed after reading in programmed instruction) the research suggests that if care is taken by the author in the analysis of the content hierarchy, one should be able to specify those relationships which when cued would generate the greatest payoffs for productive learning within specified groups of learners. On the other hand, there is reason to believe that certain learners perform best without the intervention of any imposed cue; for example, those that are highly verbal.

To the developer of instructional materials who employs questions as adjunct aids and is concerned with individual differences, this study hopefully offers a direction for applied research. It has shown that variance in performance at an abstract level of verbal learning can be predicted and accounted for. In those instances where aptitude-treatment interactions occur, there is a payoff to be gained by considering differentiated instructional strategies. But, it should be mentioned that the payoffs will not come with any certainty without more sophistication and refinement in the analysis methodology. With reference to this study, direct application of the findings are precluded for two reasons. First, is the previously cited need for better analysis techniques. Second, there is the obvious need for replication and refinements which may strengthen the case for tenuous conclusions.

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APPENDIX

Zeaman mountain Part one

In the mountain range of Zeaman, biologists have made discoveries of plant and animal life. Above 5,000 feet the mountains are covered with a thick layer of snow and ice. The cover lasts all year long. At an altitude of 8,000 feet one type of plant has been found. This plant clusters in small groves on the surface. At 9,000 feet another plant has been found which lives beneath the surface. It was first discovered only two years ago. For any plant to survive, some part of it must have direct contact with air for exchange of oxygen and carbon dioxide. The exchange of gases is the basic process of all plant life. This particualr plant sends its roots out to breathe. Villagers from the valley find the high altitude plants a delicacy to eat. The plants have the appearance of a beet. They are used in the preparation of special holiday meals.

In order to make a Type II inference (coordinate) the reader must organize and associate these ideas:

Relationship: Snow and ice cover the Zeaman mountains above 5,000 feet.

Exemplar 1: At 8,000 feet, plant "X" has been discovered.

Exemplar 2: At 9,000 feet, plant "Y" has been discovered.

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Inference: Plants "X" and "Y" live in the presence of snow and ice.

For the reader to make a Type I inference (superordinate), these ideas must be processed:

Relationship: Plants must have direct access to air for exchange of gases.

Exemplar 1: Plant "Y" lives beneath the surface.

Exemplar 2: It sends its roots out to breathe.

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Inference: Plant "Y" sends its roots <u>up</u> to the surface.

In order to achieve the Type III inference (associative), the reader must process the relevant sentences in the following manner:

Generalization (supplied by reader): Beets are red.

Exemplars: Plants "X" and "Y" have the appearance of beets.

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Inference: Plants "X" and "Y" are red.

Each of the six prose passages may be similarly analysed. Each of the six passages contains three potential inferences of the types described, for a total of 18.

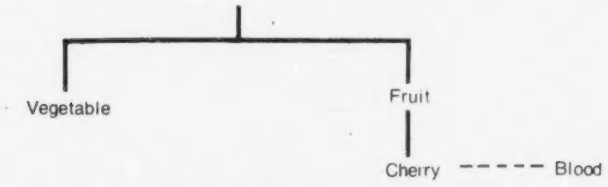


Figure 1 Hierarchical structure of example word group.

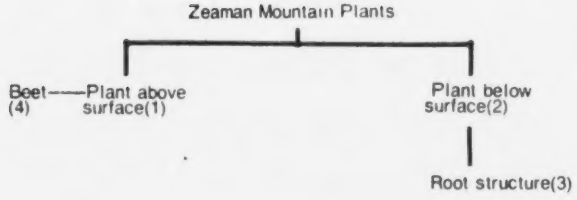


Figure 2 Hierarchical representation of stimulus paragraph 1.

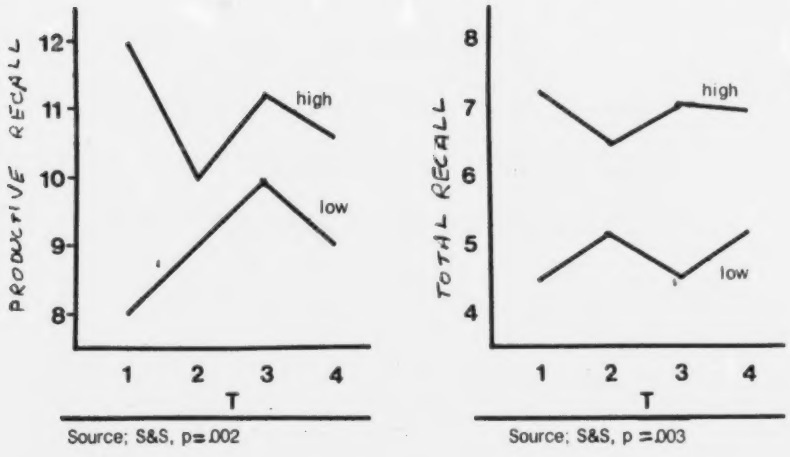
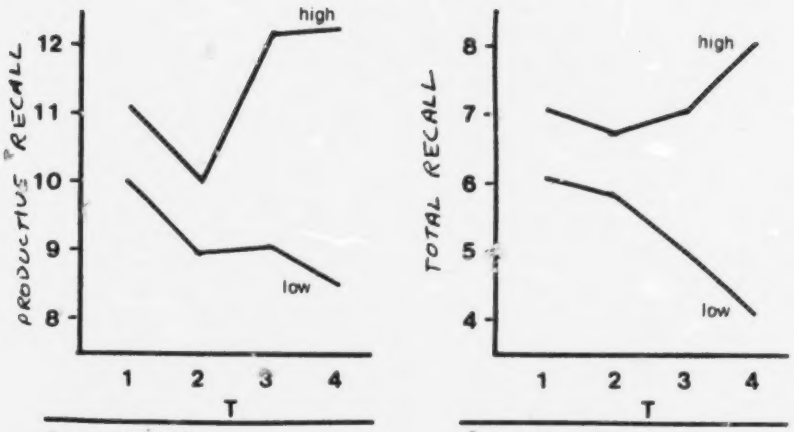
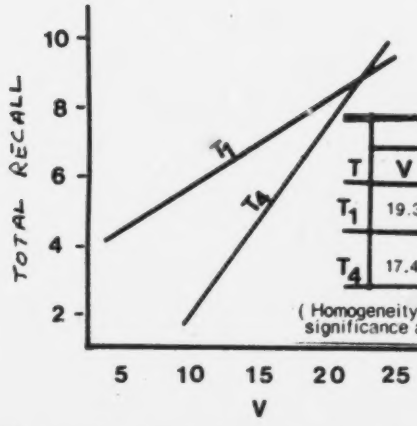


Figure 3 Recognition and recall performance for 'high' and 'low' Ss on the Siegal and Siegal measure.



Source: V, $p < .001$ Source; V, $p = .002$

Figure 4 Recognition and recall performance for 'high' and 'low' Ss on verbal aptitude.



Interaction Analysis

	X				
T	V	TR	r	Slope	Y – intercept
T_1	19.35	6.65	.441*	.214	2.502
T_4	17.40	5.15	.609*	.413	– 2.035

(Homogeneity of regression, $F = 1.49$, $p < .25$, $df = 1,36$. No regions of significance are definable. *$p < .01$)

Figure 5 Regressions between V and TR for treatments 1 and 4.

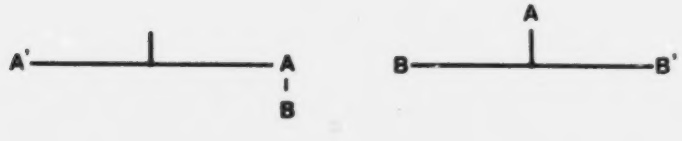


Figure 6 Content hierarchy with dual anchoring of superordinate item.

Figure 6.2 Content hierarchy with dual anchoring of coordinate items.